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Neural responses decrease while performance increases with practice: A neural network model

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Abstract: Why do neural responses decrease with practice? We used a predictive neural network model of sentence processing (St. John & McClelland, 1990) to simulate neural responses during language understanding, and examined the model's correlate of neural responses (specifically, the N400 component), measured as stimulus-induced change in hidden layer activation, across training. N400 magnitude first increased and then gradually decreased over training while comprehension performance at the output steadily rose with practice. These results fit the developmental trajectory of N400 amplitudes. Importantly, they also address the reduction of neural activation with practice. In the model, the reduction is due to continuous adaptation of connection weights over training. As connection weights between hidden and output layer grow stronger, less hidden layer activation is necessary to efficiently modulate the output. This shift of labor from activation to connection weights might be an important mechanism contributing to the reduction of neural activation with practice.